



**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2016-3872; Special Conditions No. 25-629-SC]**

**Special Conditions:** Embraer S.A. Model EMB-545 and EMB-550 airplanes, Synthetic Vision System and Enhanced Flight Vision System on Head-Up Display

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions; request for comments.

**SUMMARY:** These special conditions are issued for the Embraer S.A. (Embraer) Model EMB-545 and EMB-550 airplanes. These airplanes will have a novel or unusual design feature associated with a vision system that displays video imagery on the head-up display. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** This action is effective on Embraer S.A. on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. We must receive your comments by **[INSERT DATE 45 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER]**.

**ADDRESSES:** Send comments identified by docket number FAA-2016-3872 using any of the following methods:

- *Federal eRegulations Portal:* Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202-493-2251.

*Privacy:* The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket Web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the **Federal Register** published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

*Docket:* Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Dale Dunford, FAA, Airplane and Flightcrew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2239; facsimile 425-227-1320.

**SUPPLEMENTARY INFORMATION:**

The FAA has determined that notice of, and opportunity for prior public comment on, these special conditions is impracticable because these procedures would significantly delay issuance of the design approval and thus delivery of the affected airplane.

In addition, the substance of these special conditions has been subject to the public comment process in several prior instances with no substantive comments received. The FAA therefore finds that good cause exists for making these special conditions effective upon publication in the **Federal Register**.

**Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

**Background**

On October 9, 2014, Embraer applied for a change to Type Certificate No. TC00062IB for a synthetic vision system (SVS) and enhanced flight vision system (EFVS) on a head-up display (HUD) in Model EMB-545 and EMB-550 airplanes. These airplanes are business jets capable of accommodating up to 9 passengers (EMB-545) or 12 passengers (EMB-550).

## **Type Certification Basis**

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Embraer must show that the Model EMB-545 and EMB-550 airplanes, as changed, continue to meet the applicable provisions of the regulations listed in Type Certificate No. TC00062IB, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA. The regulations listed in the type certificate are commonly referred to as the “original type certification basis.” In addition, the certification basis includes certain special conditions, exemptions, or later amended sections of the applicable part that are not relevant to these special conditions.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model EMB-545 and EMB-550 airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, Embraer Model EMB-545 and EMB-550 airplanes must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.101.

## **Novel or Unusual Design Features**

The Embraer Model EMB-545 and EMB-550 airplanes will incorporate the following novel or unusual design feature: an enhanced-flight vision system and synthetic vision system that display video imagery on a head-up display.

## **Discussion**

Video display on the HUD constitutes new and unusual technology for which the FAA has no certification criteria. Section 25.773 does not permit visual distortions and reflections in the pilot's view out the airplane windshield that could interfere with the pilot's normal duties, and was not written in anticipation of such technology. Special conditions are therefore issued as prescribed under the provisions of § 21.16.

For many years the FAA has approved, on transport-category airplanes, the use of HUD that display flight symbols without a significant visual obstruction of the outside view. When the FAA began to evaluate the display of enhanced vision-system (EVS) imagery on the HUD, significant potential to obscure the outside view became apparent, contrary to the requirements of 14 CFR 25.773. This rule does not permit distortions and reflections in the pilot-compartment view, through the airplane windshield, that interferes with normal duties, and the rule was not written in anticipation of such technology. The video image potentially interferes with the pilot's ability to see the natural scene in the center of the forward field of view. Therefore, the FAA issued special conditions for such HUD/EVS installations to ensure that the level of safety required by § 25.773 would be met even when the image might partially obscure the outside view. While many of the characteristics of EVS and SVS video differ in some ways, they have one thing in common: the potential for interference with the outside view through the airplane windshield.

Although the pilot may be able to see around and through small, individual, stroke-written symbols on the HUD, the pilot may not be able to see around or through the image that fills the display without some interference of the outside view. Nevertheless, the vision-system video may be capable of meeting the required level of safety when considering the combined view of the image and the outside scene visible to the pilot through the image. It is essential that the pilot can use this combination of image and natural view of the outside scene as safely and effectively as the pilot-compartment view currently available without the vision-system image.

Because § 25.773 does not provide for any alternatives or considerations for such a new and novel system, the FAA establishes safety requirements that assure an equivalent level of safety and effectiveness of the pilot-compartment view as intended by that rule. The purpose of these special conditions is to provide the unique pilot-compartment-view requirements for the EFVS/SVS installation.

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

### **Applicability**

As discussed above, these special conditions are applicable to the Embraer Model EMB-545 and EMB-550 airplanes. Should Embraer apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

### **Conclusion**

This action affects only certain novel or unusual design features on one model series of airplanes. It is not a rule of general applicability.

The substance of these special conditions has been subjected to the notice and comment period in several prior instances and has been derived without substantive change from those previously issued. It is unlikely that prior public comment would result in a significant change from the substance contained herein. Therefore, because a delay would significantly affect the certification of the airplane, the FAA has determined that prior public notice and comment are unnecessary and impracticable, and good cause exists for adopting these special conditions upon publication in the **Federal Register**.

The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment described above.

#### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

#### **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions apply to all Synthetic Vision System (SVS) and Enhanced Flight Vision System (EFVS) on Head-Up Display (HUD) installations on the Embraer Model EMB-545 and EMB-550 airplanes in lieu of the requirements of § 25.773 at Amendment 25-129:

1. The synthetic vision system (SVS) or enhanced flight vision system (EFVS) imagery on the head-up display (HUD) must not degrade the safety of flight or interfere with the effective use of outside visual references for required pilot tasks during any phase of flight in which it is to be used.

2. To avoid unacceptable interference with the safe and effective use of the pilot-compartment view, the SVS or EFVS device must meet the following requirements:
- a. The SVS or EFVS design must minimize unacceptable display characteristics or artifacts (e.g. noise, “burlap” overlay, running water droplets, terrain shadowing against a dark background) that obscure the desired image of the scene, impair the pilot’s ability to detect and identify visual references, mask flight hazards, distract the pilot, or otherwise degrade task performance or safety.
  - b. Control of SVS or EFVS image-display brightness must be sufficiently effective in dynamically changing background (ambient) lighting conditions to avoid pilot distraction, impairment of the display that would distract the pilot, impairing the pilot’s ability to detect and identify visual references, masking of flight hazards, or otherwise degrading task performance or safety. If automatic control for image brightness is not provided, it must be shown that a single manual setting is satisfactory for the range of lighting conditions encountered during a time-critical, high-workload phase of flight (e.g., low-visibility instrument approach).
  - c. A readily accessible control must be provided that permits the pilot to immediately deactivate and reactivate display of the SVS or EFVS image on demand, without removing the pilot’s hands from the primary flight controls (yoke or equivalent) or thrust control.
  - d. The SVS or EFVS image on the HUD must not impair the pilot’s use of guidance information, or degrade the presentation and pilot awareness of essential flight information displayed on the HUD, such as alerts, airspeed, attitude, altitude and



direction, approach guidance, wind-shear guidance, traffic-alert and collision-avoidance system (TCAS) resolution advisories, or unusual attitude recovery cues.

- e. The SVS or EFVS image and the HUD symbols, which are spatially referenced to the pitch scale, outside view, and image, must be scaled and aligned (i.e., conformal) to the external scene. In addition, the SVS or EFVS image and the HUD symbols—when considered singly or in combination—must not be misleading, cause pilot confusion, or increase workload. Airplane attitudes or cross-wind conditions may cause certain symbols (e.g., the zero-pitch line or flight-path vector) to reach field-of-view limits, such that they cannot be positioned conformally with the image and external scene. In such cases, these symbols may be displayed, but with an altered appearance that makes the pilot aware that they are no longer displayed conformally (for example, “ghosting”). The combined use of symbology and runway image may not be used for path monitoring when path symbology is no longer conformal.
  - f. A HUD system installed to display SVS or EFVS images must, if previously certified, continue to meet all of the requirements of the original approval.
3. The display of the SVS or EFVS image must not degrade the safety and performance of the pilot tasks associated with the use of the pilot-compartment view. Pilot tasks that must not be degraded by the SVS or EFVS image include:
- a. Detection, accurate identification, and maneuvering, as necessary, to avoid traffic, terrain, obstacles, and other hazards of flight.
  - b. Accurate identification and utilization of visual references required for every task relevant to the phase of flight.

4. Appropriate limitations must be stated in the operating limitations section of the airplane flight manual to prohibit the use of the SVS or EFVS for functions that have not been found to be acceptable.

Issued in Renton, Washington, on July 27, 2016.

Victor Wicklund,  
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Aircraft Certification Service.  
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